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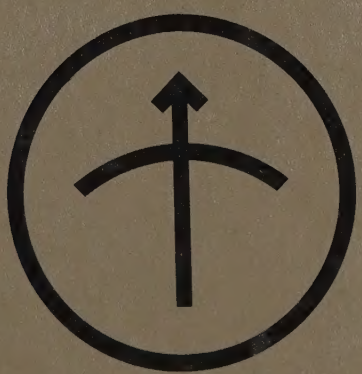
MODEL 82
STANDARD SIGNAL GENERATOR

EE 308

Operating INSTRUCTIONS



MP MASTER
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MEASUREMENTS
A McGRAW-EDISON DIVISION
BOONTON NEW JERSEY

MODEL 82
STANDARD SIGNAL GENERATOR

Operating INSTRUCTIONS

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MEASUREMENTS
A McGRAW-EDISON DIVISION
BOONTON NEW JERSEY

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Additional information with regard to the applications and maintenance of this equipment will be available from time to time. Users of the Model 82 are urged to discuss their problems with us and to suggest such modifications as might make the instrument more adaptable to their special requirements.

Maintenance difficulties should be reported to Measurements Corporation before proceeding with actual repairs, since, through our familiarity with the instrument, we are able to suggest the appropriate repair procedure.

Engineering Department

MEASUREMENTS CORPORATION

Boonton, New Jersey

U. S. A.

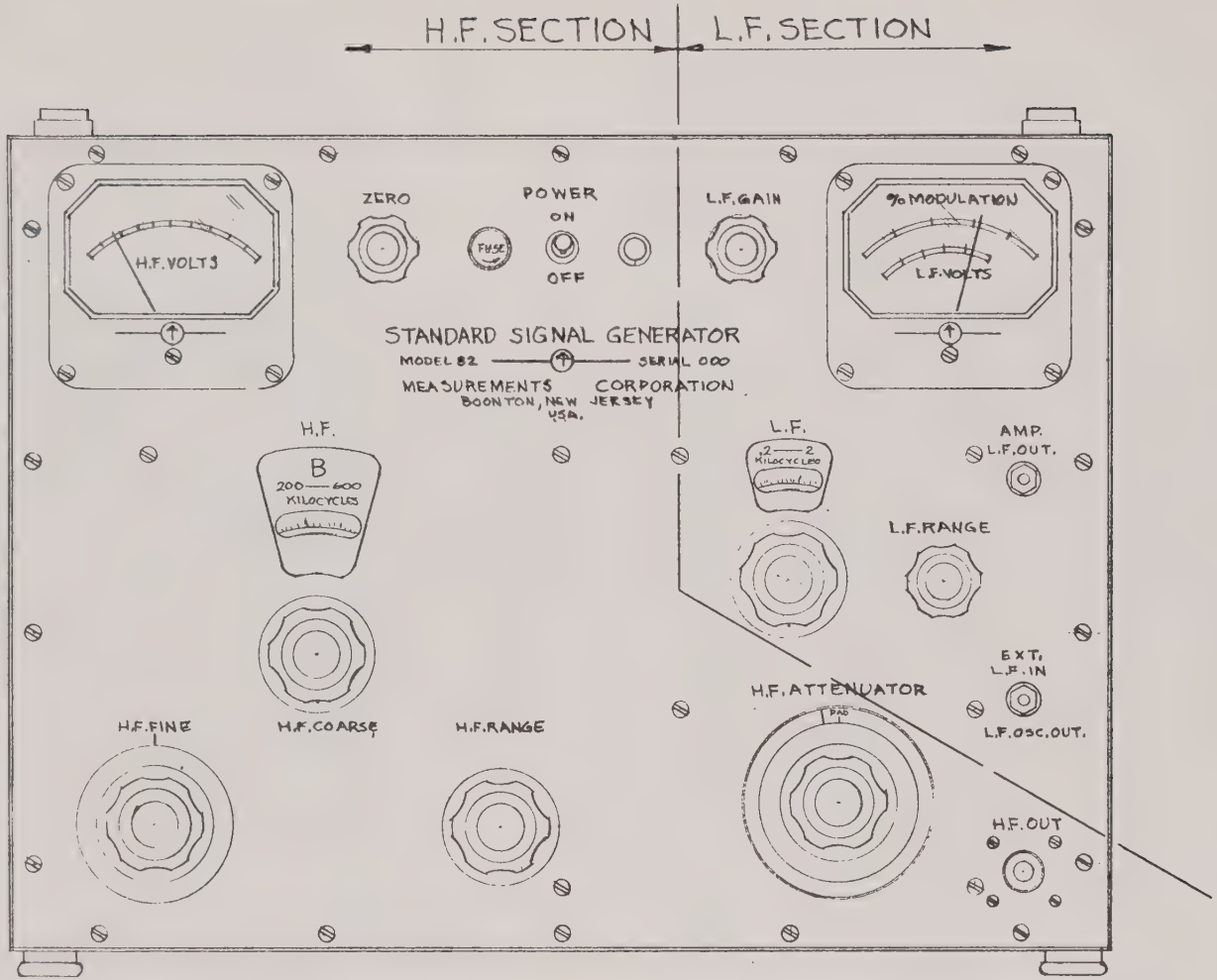

Figure 1. Front View of Model 82 Standard Signal Generator.

CHAPTER 1

INTRODUCTION

SECTION I

GENERAL

1. SCOPE OF MANUAL

a. This manual describes the basic operation, construction and maintenance of the Model 82 Standard Signal Generator. Following the text of the manual are two appendices. Appendix I describes the recommended procedure for preparing the instrument for prolonged storage or reshipment. Appendix II contains a Table of Replaceable Parts listing the reference symbols, name and description, and part number of each part required for maintenance.

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SECTION II

DESCRIPTION AND DATA

2. GENERAL

a. The Model 82 Standard Signal Generator, see Figure 1, is a portable electronic instrument providing signal voltage of accurately known frequency and amplitude for testing audio-, supersonic-, and radio-frequency devices. The Model 82 is designed for use as a laboratory standard, and for use in production testing or field maintenance of communication, supersonic and video equipment. The Model 82 consists of a low-frequency R-C oscillator, and a high-frequency L-C oscillator with associated attenuators, voltmeter circuits and power supply.

3. TECHNICAL CHARACTERISTICS

a. Low-frequency Section.

(1) Frequency Range - 20 cycles to 200 kilocycles in the following four ranges:

20 to 200 cycles
.2 to 2 kilocycles
2 to 20 kilocycles
20 to 200 kilocycles

(2) Frequency Accuracy - Individually calibrated dials accurate to ± 5%.

(3) Output Voltage - Continuously variable output of 0 to 50 volts directly indicated on output meter.

(4) Output Impedance - The direct terminating load impedance should be 7500 ohms, or higher. External pads, or attenuators, such as Measurements Corporation's M-487, may be employed to reduce the impedance and voltage level.

(5) Output Accuracy - The output voltage accuracy at 50 volts is ± 10%.

(6) Harmonic Output - Less than 1% from 20 to 20,000 cycles. Less than 3% above 20,000 cycles.

b. High-frequency Section.

(1) Frequency Range - 80 kilocycles to 50 megacycles in the following seven ranges:

Band	Frequency Range
A	80 to 200 kilocycles
B	200 to 500 kilocycles
C	0.5 to 1.5 megacycles
D	1.5 to 3.5 megacycles
E	3.5 to 9 megacycles
F	9 to 20 megacycles
G	20 to 50 megacycles

A blank eighth range position with a blank coil tray is provided for special frequency range requirements.

(2) Frequency Accuracy - Individually calibrated dials accurate to ± 1%.

(3) Output Voltage - Continuously variable mutual inductance attenuator is directly calibrated from 0.1 microvolt to 0.3 volts across 50-ohm load. Output of 0.3 volt to 1 volt is provided over most of the range from 80 Kc to 50 Mc. (The maximum output for the A and G ranges may be considerably less than 1 volt). Outputs above 0.3 volt are indicated on the panel HF VOLTS meter.

(4) Output Accuracy - The output voltage accuracy at the 0.3 volt level is ± 10%. The incremental accuracy of the mutual inductance attenuator is high, since this accuracy depends on physical dimensions which are held to a close tolerance.

(5) Output Impedance - The high-frequency oscillator is calibrated in terms of the voltage developed across a 50-ohm load. The source impedance consists of the impedance of a multi-turn pick-up coil in the attenuator connected to a short length of 50-ohm output cable. In those cases where it is desirable to have a 50-ohm source impedance, Measurements Corporation pads listed in Chapter 4 should be employed.

(6) Harmonic Output - Less than 3%.

(7) Modulation - Continuously variable from 0 to 50% from 20 to 20,000 cycles. The low-frequency oscillator provides the internal modulation frequency. External modulation may be employed over the frequency range of 20 to 20,000 cycles.

c. General.

(1) Power Supply - 117 volts, 50 to 60 cycles, 75 watts.

(2) Mounting - The Model 82 may be mounted on a standard 19-inch relay rack when removed from its case. The four mounting holes on each vertical edge of the panel should be enlarged sufficiently to take the rack mounting screws.

4. COMPONENTS SUPPLIED

a. See Table I. Table of Components.

TABLE I. TABLE OF COMPONENTS

Quan.	Description	Case Dimensions			Unit Weight	Volume Cu. Ft.
		Height	Width	Depth		
1	Model 82 Standard Signal Generator.	14"	19"	10-1/4"	50 lbs.	1.6
1	Handbook of Operating Instructions.					
1	Tube, 5Y3-GT, installed.					
1	Tube, 6Y6-G, installed.					
1	Tube, 6AG7, installed.					
3	Tube, 6SJ7, installed.					
1	Tube, 0C3, installed.					
1	Tube, 6J7, installed.					
1	Tube, 6V6-GT, installed.					
2	Tube, 6AL5, installed.					
1	Tube, 6C4, installed.					

5. EXPORT PACKAGING

a. For export, the Model 82 is packed in a wooden box.

TABLE II. EXPORT PACKAGING DATA

Number of Packages	Case Dimensions			Weight	Volume
	Height	Width	Depth		
1	24"	32"	20"	107#	8.8 cu. ft.

CHAPTER 2

OPERATING INSTRUCTIONS

SECTION I

SERVICE UPON RECEIPT OF EQUIPMENT

6. UNPACKING

a. Take care when unpacking or handling the equipment. Follow the procedure outlined below when unpacking the instrument.

(1) Place the packing case in a location where it can be opened easily.

(2) Remove nails with a nail puller and remove the top of the packing case.

(3) Lift the generator from the packing case and remove the paper wrapping.

(4) Inspect the case and controls on the front panel for possible damage during shipment.

7. PRELIMINARY PRECAUTIONS

a. Before connecting the Model 82 to the power source, it is good practice to ground the instrument. Each side of the power line is bypassed to the case through a small capacitor. These capacitors pass a current which may be sufficient to result in slight shock to operating personnel if the case is left ungrounded. See Para. 24.

b. During operation make certain there is ample clearance between the rear of case and wall or other object to provide sufficient ventilation.

SECTION II

CONTROLS AND INSTRUMENTS

8. POWER

a. The POWER switch, S-1, located at the top center of the panel controls application of voltage to the primary winding of transformer T-1.

9. H.F. VOLTS Meter

a. The H.F. VOLTS meter, M-1, located in the upper left-hand corner of the front panel, indicates the output voltage of the high-frequency oscillator. For output voltages less than 0.3 volt (300,000 microvolts) the meter is set to the red line marked ATTEN. SET and the output is read directly from the MICROVOLTS dial of the H.F. ATTENUATOR. Output voltages from 0.3 volt to 1.0 volt are indicated directly on the meter by following the procedure of Para. 11.

10. ZERO

a. The ZERO control located to the right of the H.F. VOLTS meter is used to adjust the pointer of this meter to read ZERO when no voltage is supplied to the H.F. ATTENUATOR. This adjustment is made with the H.F. RANGE switch set between coil detent positions.

11. H.F. ATTENUATOR

a. The H.F. ATTENUATOR, located at the lower right-hand edge of the panel, controls the output of the high-frequency oscillator and consists of two adjustable controls. The outer bakelite ring establishes the voltage level, as indicated by the meter, while the inner MICROVOLTS dial provides accurate calibration of output voltage below 300,000 microvolts. When output voltage above 0.3 volt is desired, the 300K calibration point on the MICROVOLTS dial is set opposite the long fiducial mark on the outer ring which is then used to adjust the output voltage, the value of which will be indicated by the H.F. VOLTS meter. When output voltage below 0.3 volt is required, the meter is set to the red line marked ATTEN. SET by means of the outer ring and the output in microvolts adjusted by means of the MICROVOLTS dial. For greatest accuracy below 1 megacycle, the correction factors found in Figure 2 should be employed. When a 2:1 voltage ratio (6 db) pad is used with the Model 82, the voltage at the output of the pad may be read directly opposite the fiducial line marked PAD on the outer ring of the attenuator.

12. H.F. OUT

a. The H.F. OUT jack, J-3, located in the lower right-hand corner of the panel, is a type-N female connector which provides means for connecting the high-frequency oscillator to equipment under test.

13. H.F. RANGE

a. The H.F. RANGE control, located at the bottom center of the panel, selects the desired band of the high-frequency oscillator. The band selected is indicated in the window marked H.F.

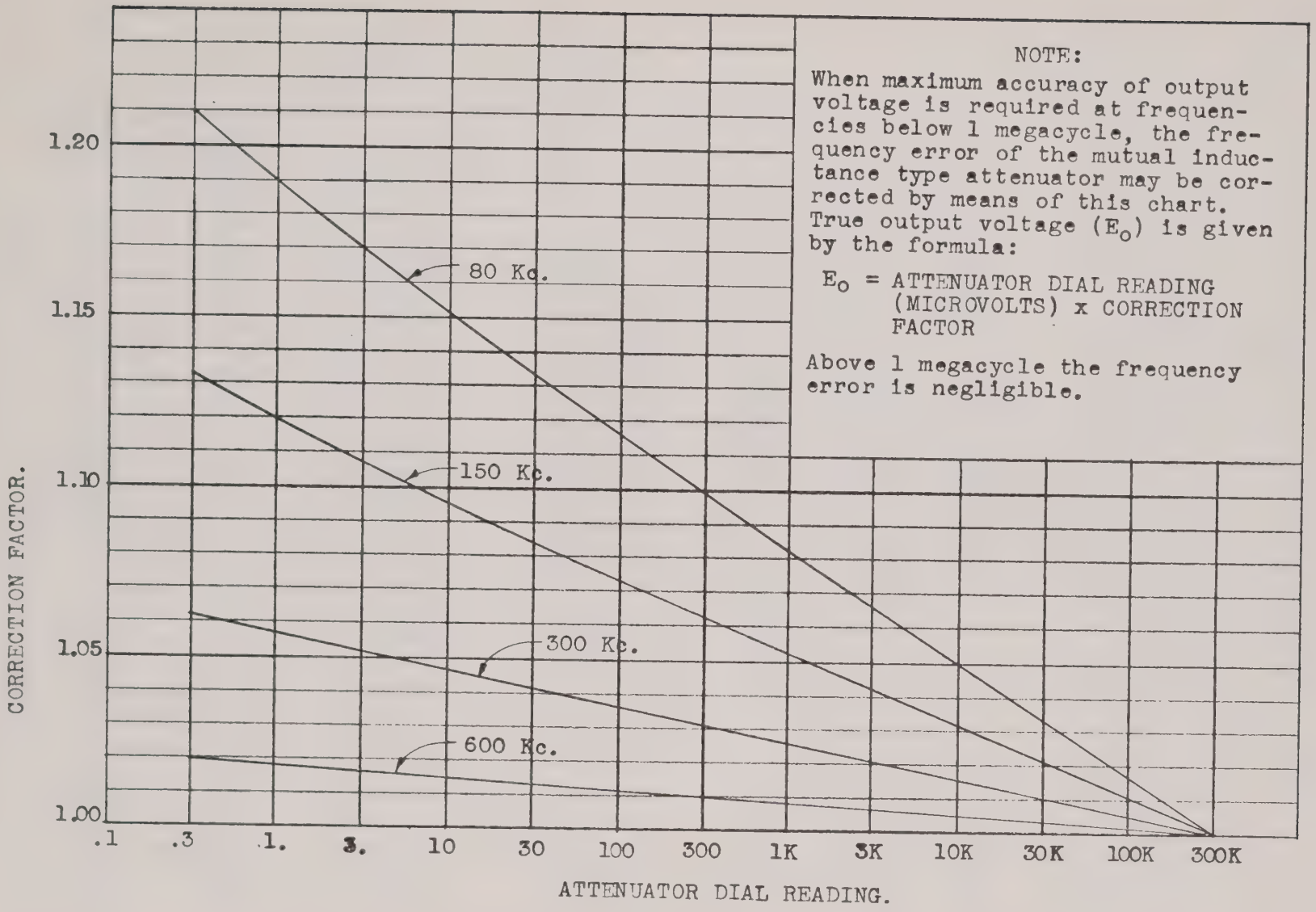


Figure 2. Attenuator Correction Curves

14. H.F. COARSE

a. The H.F. COARSE knob located below the H.F. window provides coarse tuning of the high-frequency oscillator.

15. H.F. FINE

a. The H.F. FINE dial located in the lower left corner of the panel provides vernier tuning of the high-frequency oscillator. This dial may be reset to zero at any frequency setting by pressing the knob downward to disengage the pinion gear, and then rotating the dial until the zero calibration is opposite the fiducial line.

16. % MODULATION - L.F. VOLTS Meter

a. The % MODULATION - L.F. VOLTS meter, M-2, located in the upper right-hand corner of the front panel, serves a dual purpose:

(1) When the low-frequency oscillator is used to modulate the high-frequency oscillator, or when external modulation is used, M-2 indicates the percent modulation from 0 to 50% modulation.

(2) When the low-frequency oscillator is used as a signal generator, M-2 indicates the magnitude of the output voltage from 0 to 50 volts.

17. L.F. GAIN

a. The L.F. GAIN control located to the left of the % MODULATION - L.F. VOLTS meter permits adjustment of the value of output voltage from the low-frequency oscillator. It also determines the modulation percentage when either the internal low-frequency oscillator or an external oscillator is used to modulate the high-frequency oscillator.

18. L.F. RANGE

a. The L.F. RANGE knob located on the right-hand side of the panel operates switch S-2 and selects the frequency range of the low-frequency oscillator. The selected range is indicated on the mask in the window marked L.F. The low-frequency oscillator is tuned by the knob directly beneath this opening.

19. AMP. L.F. OUT

a. The AMP. L.F. OUT jack, J-2, located beneath the L.F. VOLTS meter provides means for connecting the low-frequency oscillator to external circuits.

20. EXT. L.F. IN - L.F. OSC. OUT

a. The EXT. L.F. IN - L.F. OSC. OUT jack, J-1, located below the AMP. L.F. OUT jack serves a dual purpose:

(1) It provides means for connecting an external oscillator to the internal amplifier and modulator in order to modulate the high-frequency oscillator with an external modulating voltage.

(2) In Model 82 instruments starting with Serial Number 607, the low-frequency output with a fixed level of approximately 10 volts is available from this jack at the same time that the high-frequency output is available from the H.F. OUT jack. (Loads connected to the L.F. OSC. OUT jack should have an impedance of at least 100,000 ohms as lower impedances may cause increased distortion or failure to oscillate.) The L.F. GAIN control must be turned fully counter-clockwise if it is desired that the high-frequency output be an unmodulated carrier.

SECTION III

OPERATION

21. INSTALLATION AND ADJUSTMENT

a. The Model 82 Standard Signal Generator is portable test equipment and no permanent installation is required. Sufficient clearance should be provided between the rear of case and other objects to insure ample ventilation. No preliminary adjustments are required prior to operation.

CAUTION:

Ground outer case as described in Paragraph 24 to avoid possibility of slight shock.

22. PRELIMINARY OPERATIONAL CHECKS

a. Connect line cord to a source of 117 volt, 50- to 60 cycle power and place POWER switch, S-1, in ON position. Allow at least one minute for tubes to warm up.

b. Rotate L.F. RANGE knob until 20-200 cycles range appears on mask in the window marked L.F.

(1) Rotate L.F. GAIN knob clockwise; the output voltage will be indicated by the % MODULATION - L.F. VOLTS meter, M-2. Full-scale deflection of L.F. VOLTS scale of the meter should be obtained at any frequency.

NOTE:

Below 30 cycles, vibration of the meter pointer will be observed. This condition is normal and is not an indication of trouble.

c. Select, in turn, each of the remaining frequency ranges of the low-frequency oscillator. Full-scale deflection of L.F. VOLTS scale of the meter should be obtained at any frequency.

d. Rotate H.F. RANGE knob to a point between range positions and check zero of H.F. VOLTS meter, M-1.

e. Rotate H.F. RANGE knob until the "A" range appears in the window marked H.F.

NOTE: When checking the high-frequency oscillator, the L.F. RANGE switch should not be in its high-frequency position, (20-200 Kcs). When placed in this position, plate voltage is disconnected from the h-f oscillator tube, V-8.

(1) Rotate ring fiducial (outer bakelite ring) of H.F. ATTENUATOR clockwise. Output voltage should be indicated by the H.F. VOLTS meter. M-1. Full-scale deflection will be obtained over most of "A" band, but the output may drop to considerably less than 1 volt at 80 kilocycles.

f. Check H.F. RANGE "G" for output. Full output (1 volt) should be obtained over most of "G" band, but output may be considerably less than 1 volt at 50 megacycles.

g. Check the remaining H.F. ranges for output. Full output (1 volt) should be obtained at any frequency.

h. Any indication of faulty operation should be reported immediately to Measurements Corporation.

23. CONNECTIONS FOR OPERATION

a. Low-frequency Oscillator.

(1) A pair of leads terminated at one end with a standard 2-terminal phone plug for insertion into the L.F. OUT jack, J-2, will be satisfactory for this connection, provided the input impedance of the load is approximately 7500 ohms or higher.

(2) When the load impedance is less than 7500 ohms, a suitable pad or high-quality output transformer should be used between the L.F. OUT jack and load to prevent distortion.

b. High-frequency Oscillator.

(1) Refer to Chapter 4, for a list of cables and impedance-matching pads suitable for making connection between the H.F. OUT jack, J-3, and equipment under test. Refer also to Figure 3.

(2) Use 50-ohm cable type 80-ZH4 for general laboratory measurements.

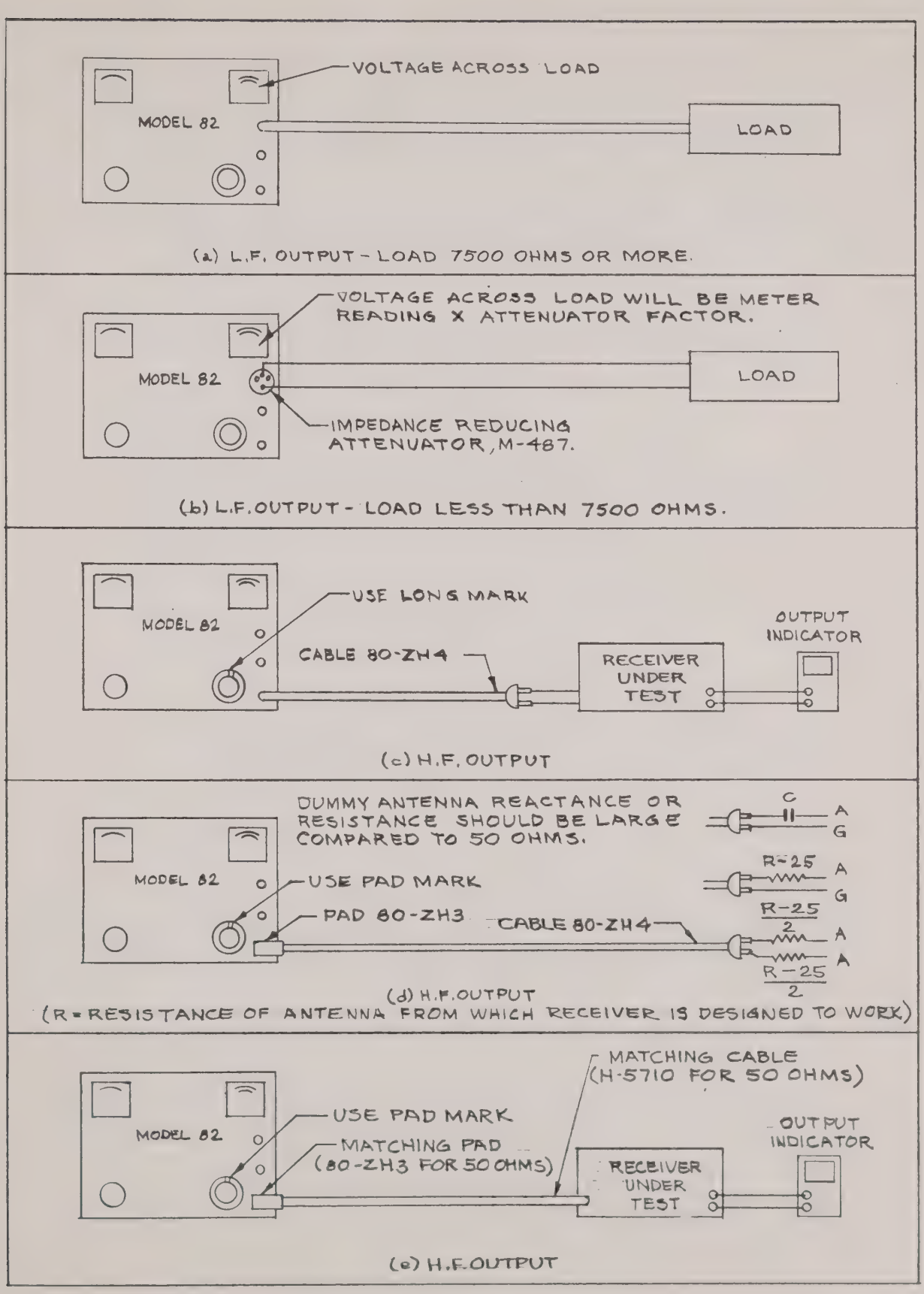


Figure 3. External Connections

NOTE: A 50-ohm type 80-ZH3 pad should always be used between the output jack on the generator and the cable when maximum accuracy and a 50-ohm source impedance is desired; the open-circuit voltage at the output binding posts of the cable is then indicated by the "PAD" mark on the ring fiducial.

(3) Always use short connecting leads between the binding posts terminating the output cable and the equipment under test. This is particularly important when making measurements at the higher radio frequencies.

(4) When the input impedance of the equipment under test properly terminates the cable used between generator and load, the connection shown in Figure 3(e) may be used.

c. Use of external modulator.

(1) The low-frequency oscillator normally serves as the modulator for the high-frequency oscillator. When the use of an external modulator is desired, however, proceed as described below:

(a) Rotate L.F. RANGE knob to EXT position.

(b) Connect external modulator to EXT. L.F. IN - L.F. OSC. OUT jack, J-1.

NOTE: Approximately 7 volts are required at this jack to modulate the carrier 50%.

(c) Output voltage at the AMP. L.F. OUT jack, or modulation percentage, is indicated by the % MODULATION - L.F. VOLTS meter.

24. SET-UP PROCEDURE

a. Connect a wire from case of Model 82 to ground to avoid possibility of slight shock. If an external oscillator is not used this connection may be easily made by inserting a 2-terminal phone plug into the EXT. L.F. IN jack and connecting a wire between the sleeve connector and ground, or by connecting a lead under one of the panel screws.

b. Connect the line cord to a source of 117 volt, 50- to 60-cycle power.

c. Place POWER switch in ON position and allow at least one minute for tubes to heat up.

25. USE OF LOW-FREQUENCY OSCILLATOR

a. Connect equipment under test to AMP. L.F. OUT jack by means of the two-wire cable described in Paragraph 23-a-(1) or by means of an impedance-matching pad.

b. Output voltage is controlled by the L.F. GAIN knob and is indicated by L.F. VOLTS scale of % MODULATION - L.F. VOLTS meter.

c. Rotate the L.F. RANGE knob until the desired frequency range appears in the L.F. window.

d. The test frequency is selected by the tuning knob directly under the window.

26. USE OF HIGH-FREQUENCY OSCILLATOR

a. Connect equipment under test to H.F. OUT jack by means of suitable cable as described in Paragraph 23-b.

b. Rotate the H.F. RANGE knob until the desired carrier frequency range appears in the H.F. window.

c. Rotate the H.F. COARSE knob until the desired frequency is opposite the fiducial line.

d. Final tuning is completed by means of the H.F. FINE dial.

NOTE: Incremental frequency measurements about any center frequency may be facilitated by pressing downward on the H.F. FINE knob and, while the gears are disengaged, rotating the dial until its zero is opposite the fiducial mark.

e. To obtain continuous-wave carrier output, (CW), rotate the L.F. RANGE knob to OFF.

f. To obtain modulated carrier output (MCW), rotate L.F. RANGE knob to desired L.F. RANGE, tune to desired modulation frequency and adjust L.F. GAIN knob to produce required modulation depth as indicated by % MODULATION scale of % MODULATION - L.F. VOLTS meter.

g. Adjust output voltage by means of ring fiducial and MICROVOLTS dial.

(1) Set H.F. VOLTS meter to ATTEN. SET line (0.3 volt) by means of outer bakelite ring of H.F. ATTENUATOR and read output voltage in microvolts directly opposite long fiducial line from MICROVOLTS dial. For greatest accuracy below 1 Mc the correction factors in Fig. 2 should be employed.

(2) When high voltage output (above 0.3 volt) is required, set 300K calibration point on MICROVOLTS dial opposite the fiducial mark and adjust output voltage by means of ring fiducial to desired voltage as read on H.F. VOLTS meter.

(3) When the Type 80-ZH3 Pad described in Chapter 4 is used, the "PAD" mark on the ring becomes the output reference line. Maximum output, when using this 2:1 voltage ratio pad, is 0.5 volt (500,000 microvolts).

CHAPTER 3

MAINTENANCE INSTRUCTIONS

SECTION I

MAINTENANCE

27. GENERAL

a. Preventive maintenance procedure is not recommended for the Model 82. Preventive maintenance is a series of operations including inspection, adjustment, lubrication, etc. recommended periodically for certain types of equipment to eliminate the possibility of unexpected interruptions in service. Critical adjustments may be disturbed by too frequent inspection by personnel unfamiliar with the design of the Model 82 causing errors in data that would be much more serious than an occasional operational failure.

b. When failure occurs, the instrument should be checked by the procedure outlined in Paragraph 22 (Preliminary Operational Checks), and if trouble other than a defective tube is indicated, the instrument should preferably be returned to Measurements Corporation.

c. For analyzing troubles, see Charts in Table IV and Table V, pages 22 through 25.

CHAPTER 4

EQUIPMENT USED IN CONJUNCTION WITH MODEL 82

SECTION I

ACCESSORIES

28. LIST OF RECOMMENDED ACCESSORIES

a. A list of accessories recommended for use with the Model 82, with a short description of each part, is given below.

TABLE III. RECOMMENDED ACCESSORIES

Meas. Corp. Part No.	Description
H-5710 Cable	Consists of 4-ft. length of RG-55/U 50-ohm coaxial cable terminated on each end with 50-ohm type-N male connectors.
80-ZH4 Cable	Consists of 4-ft. length of RG-55/U 50-ohm coaxial cable terminated in a 50-ohm type-N male connector at one end and in a pair of banana binding posts (3/4" centers) with a 50-ohm terminating resistor at the other end.
84-Z2-2 Cable	Consists of 4-ft. length of RG-8/U 50-ohm coaxial cable terminated in a UHF male connector at one end and in a 50-ohm type-N male connector at the other end.
80-ZH3 Pad	A 50-ohm symmetrical T pad with a 2:1 voltage ratio (6 db insertion loss) and a low VSWR. Input connector is 50-ohm type-N male which mates with H.F. OUT jack of Model 82. Output connector is type-N female which mates with the H-5710, 80-ZH4 and 84-Z2-2 cables.

TABLE III. RECOMMENDED ACCESSORIES

Meas. Corp. Part No.	Description
M-487 Attenuator	A ladder-type attenuator arranged to plug directly into the AMP. L.F. OUT panel jack of the Model 82. The nominal output impedance is 600 ohms. Voltage ratios X1, X.1 and X.01 on open circuit and X.05 and X.005 when terminated in 600 ohms. Output connectors are banana binding posts on 3/4" centers.

CHAPTER 5

TECHNICAL SERVICE - MAINTENANCE INSTRUCTIONS

SECTION I

GENERAL

29. SCOPE

a. The purpose of this chapter is to acquaint operating and maintenance personnel with the theory of operation of the various circuits in the Model 82 Standard Signal Generator and to describe recommended adjustment procedures.

b. Return the instrument to Measurements Corporation whenever repairs involving replacement of components is necessary.

SECTION II

CONDENSED THEORY OF OPERATION

30. GENERAL

a. A block diagram of the Model 82 is shown in Figure 4.

b. The Model 82 consists of two independent oscillator units. The output voltage of each oscillator is continuously metered and adjustable. The low-frequency oscillator may be used as modulator for the high-frequency oscillator within the range 20 to 20,000 cycles.

c. A low-gain amplifier isolates the low-frequency oscillator from the output jack and h-f load. Output voltage and modulation percentage are controlled by a potentiometer in the input grid of this amplifier. The amplifier also serves as an electronic plate supply regulator for the high-frequency oscillator.

31. HIGH-FREQUENCY OSCILLATOR

a. A 6C4 tube, V-8, is used in a plate-modulated oscillator circuit. Modulation voltage is applied, in series with the plate-coil of the oscillator circuit. An r-f filter consisting of coils L-1 and L-2 and capacitors C-16, C-17 and C-37, prevents high-frequency leakage through the high-voltage plate supply lead.

> NOTE: On bands A, B, C and D, a tuned-plate type oscillator circuit is used while on bands E, F and G, a split Colpitts circuit is employed.

b. Band switching is accomplished by rotating a disc on which the seven coil assemblies are mounted. Positive detent mechanism insures proper positioning of the coil.

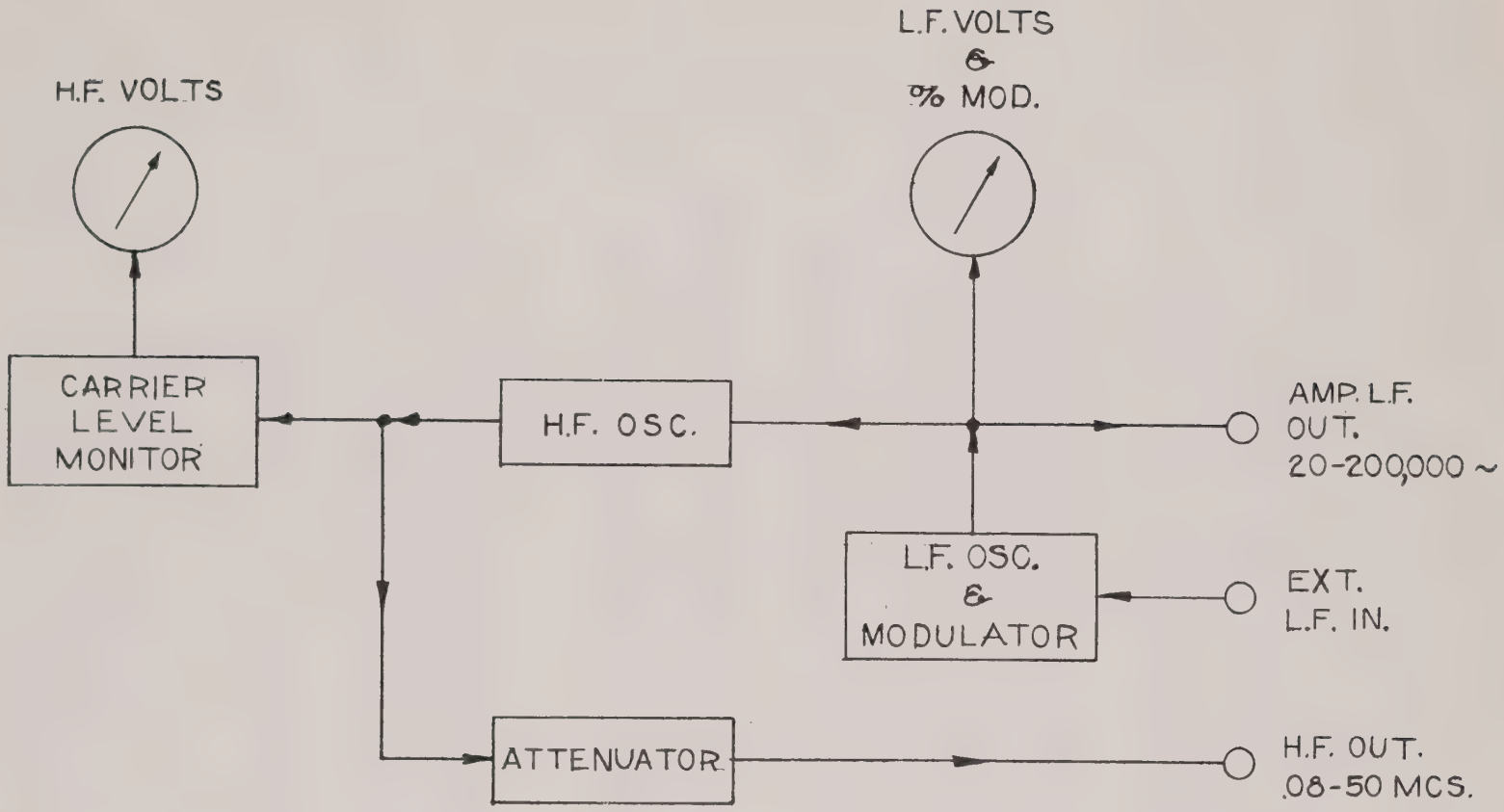


FIG. 4 - BLOCK DIAGRAM
OF MODEL 82

c. The oscillator coil assembly in use is coupled magnetically to pick-up coils L-5 and L-6 in the attenuator assembly. This attenuator is commonly referred to as a mutual inductance type and operates as a wave-guide below cut-off frequency. Output coupling coils, L-5 and L-6 are mounted on separate sliding tubes which are adjacent to each other. The rate of attenuation is dependent on the diameter of the attenuator tube, and at low frequencies the decreased skin effect causes the radio-frequency current to penetrate deeper into the attenuator tube walls bringing about an apparent increase in diameter,and thus, altering the rate of attenuation. This effect is negligible above 1 megacycle, but for greatest accuracy below this frequency the correction factors found in Figure 2 should be employed.

d. The ring fiducial (outer bakelite ring of H.F. ATTENUATOR) positions both coils simultaneously and determines the reference output potential level as indicated by the HF. VOLTS meter, M-1. Coil L-6 is the reference voltage sampling coil. A co-axial cable terminated in its characteristic impedance couples coil L-6 to tube V-9 which functions as a diode rectifier to drive a balanced d-c amplifier V-11 and V-12, which in turn, operates the output meter M-1 (H.F. VOLTS). One-half of diode tube V-10 supplies a balancing contact potential equal to that developed by tube V-9 and serves to stabilize the output meter zero settings for varying line voltages.

e. The MICROVOLTS dial controls the position of the pick-up loop L-5. This coil is connected by co-axial cable to the H.F. OUT jack. When the H.F. VOLTS meter is set at 0.3 volt, the voltage appearing across a terminated 50-ohm cable (for example, our Type 80-ZH4) is indicated directly by the MICROVOLTS dial.

32. LOW-FREQUENCY OSCILLATOR

a. The low-frequency oscillator comprises two tubes, V-6 and V-7, operating on the resistance-capacitance-tuned principle. Regeneration between these tubes is controlled by a frequency selective network in the grid of tube V-6 consisting of variable capacitor C-14 and fixed resistors R-21 through R-24 and R26 through R-29.

b. A portion of the voltage at the plate of tube V-7 is applied through potentiometer R-16 (L.F. GAIN) to the grid of the modulating amplifier.

33. POWER SUPPLY AND MODULATOR

a. A modified version of the conventional electronically-regulated power supply is used in the Model 82. Plate current through the voltage regulator tube V-3 is controlled through amplifier tube V-4 by the cathode bias of tube V-5. This bias is a function of the output voltage at the cathode of tube V-3.

b. Application of signal voltage to the control grid of tube V-5 will vary the magnitude of output voltage at the cathode of tube V-3 at signal frequency resulting in modulation of the d-c plate potential of oscillator tube V-8.

c. Modulation voltage may be obtained from the internal low-frequency oscillator or an external oscillator attached to EXT. L.F. IN - L.F. OSC. OUT jack, J-1. Its magnitude is controlled by L.F. GAIN potentiometer R-16.

d. Regulated voltage for the amplifier tube V-5 is obtained by means of selenium rectifier CR-1 and regulator tube V-2.

e. A diode tube voltmeter consisting of one half of tube V-10 and L.F. VOLTS meter, M-2, indicates the magnitude of the modulation voltage.

SECTION III

PRE-ADJUSTMENT PROCEDURE

34. TEST EQUIPMENT

a. The following test equipment should be available for adjustment purposes:

Vacuum Tube Voltmeter, Measurements Model 62, or equivalent.

Oscilloscope, usable within the range 20 to 200,000 cycles.

D-C Voltmeter, sensitivity at least 1000 ohms per volt.

b. The power source should be capable of delivering 300 watts at 117 volts, 50/60 cycles, in order to provide power for the Model 82 and the associate test equipment.

SECTION IV

TROUBLE LOCATION

35. LOCALIZING THE TROUBLE

a. Trouble may be quickly localized by making the preliminary operational checks described in Paragraph 22 and charts below.

b. A chart showing normal tube voltages is given in Table V.

TABLE IV. TROUBLE SHOOTING CHART

Trouble	Possible Cause	Remedy
Pilot lamp does not light.	Defective power plug or receptacle.	Check both for poor connection.
	Blown fuse (F-1).	Replace fuse.
	Defective power switch (S-1).	Replace switch.
	Defective pilot lamp (E-1).	Replace lamp.
No H.F. VOLTS meter reading.	L.F. RANGE switch (S-2) in 20-200 Kcs position.	Select a lower frequency range.
	H.F. RANGE in blank position or between ranges.	Select an active range.
	Ring fiducial in maximum counter-clockwise position.	Rotate ring fiducial clockwise.
	Defective rectifier tube (V-1).	Replace tube (check for reading on L.F. VOLTS meter before replacing tube).
	Shorted capacitor (C49).	Replace capacitor.
	Defective oscillator tube (V-8).	Replace tube.
	Defective rectifier (CR-2).	Replace rectifier.
H.F. VOLTS meter cannot be adjusted for zero reading.	Defective diodes (tubes V-9 or V-10).	Replace both tubes with matched pair. See Para. 43.
	Defective V-11 or V-12.	Replace tubes.

TABLE IV. TROUBLE SHOOTING CHART

Trouble	Possible Cause	Remedy
No reading on L.F. VOLTS meter.	L.F. GAIN control rotated too far counter-clockwise.	Rotate L.F. GAIN knob clockwise.
	L.F. RANGE switch (S-2) in EXT. or OFF position.	Select an active range.
	Defective modulator. Place L.F. RANGE switch (S-2) in EXT. position and apply a signal between 20 and 20,000 cycles; rotate L.F. GAIN control clockwise.	If no reading, replace tubes V-5, V-4, V-3 and V-2 in order named.
	Defective oscillator. (If reading is obtained on above test).	Replace tubes V-6, V-7 one at a time.
	Defective meter diode tube (V-10).	Replace V-9 and V-10 in matched pairs. See Para. 43.

TABLE V. TUBE VOLTAGE CHART

TUBE		PLATE		SCREEN		GRID		CATHODE	
No.	Type	Pin	Volts	Pin	Volts	Pin	Volts	Pin	Volts
V-1	5Y3-GT	4 6	325 AC 325 AC	- -	- -	-	-	2 to 8 8	5.0 AC 320 DC
V-2	0C3	5	Ground	-	-	-	-	2	-105 DC
V-3	6Y6-G	3	320 DC	4	270 DC	5	170 DC	8	180 DC
V-4	6AG7	8	170 DC	6	90 DC	4	-3.2 DC	5	Ground
V-5	6SJ7	8	-3.2 DC	6	Ground	4	-75 DC	5	-75 DC
V-6	6J7	3	205 DC	4	90 DC	CAP	0 DC	8	3.0 DC
V-7	6V6-GT	3	165 DC	4	90 DC	5	0 DC	8	4.6 DC
V-8	6C4	1,5	175 DC	-	-	6	-	7	Ground

TABLE V. TUBE VOLTAGE CHART

TUBE		PLATE		SCREEN		GRID		CATHODE	
No.	Type	Pin	Volts	Pin	Volts	Pin	Volts	Pin	Volts
V-9	6AL5	2 7	Ground 0	- -	- -	- -	- -	5 1	Ground .1 to 2 DC
V-10	6AL5	2	-.15 DC Ground	- -	- -	- -	- -	5 1	Ground Ground
V-11	6SJ7	8	150 DC	6	150 DC	4	.05 DC	5	0 to ± 10 DC
V-12	6SJ7	8	150 DC	6	150 DC	4	.1 to 2 DC	5	0 to ± 10 DC

DC voltages measured to ground with 20,000-ohms-per-volt meter.

AC voltages are r.m.s. measured to ground, unless otherwise noted, with 1,000-ohms-per-volt meter.

Output controls set at minimum output -

H.F. Range switch on "A" Band
L.F. Range switch on .2-2 kilocycle Band.

SECTION V

ADJUSTMENT PROCEDURES

36. GENERAL

CAUTION!

Do not attempt to adjust any control before reading the following instructions.

a. Remove screws holding case to front panel and lift instrument from case.

37. H.F. VOLTS METER ADJUSTMENTS

a. Failure of either of the d-c meter amplifier tubes (V-11 and V-12) will cause the H.F. VOLTS meter to deflect off scale. If either of these tubes become defective, it will be necessary to replace both with a matched pair. Replacement of h-f meter diode V-9 should not be attempted unless absolutely necessary as the H.F. VOLTS meter scale is accurately calibrated to this diode at the factory.

b. After repairs to the h-f meter system, the following adjustments should be made:

(1) Ground the grids of both 6SJ7 tubes (pins 4 of V-11 and V-12) with short clip leads. Set H.F. VOLTS meter to zero with ZERO control (front panel). Remove grounding clip leads.

(2) Rotate H.F. RANGE switch between ranges. Set H.F. VOLTS meter to zero with A.C. BAL control, R-53.

(3) Connect a terminated 50-ohm cable (Meas. Corp. Type 80-ZH4) to H.F. OUT jack. Connect probe of the Model 62 Vacuum-Tube Voltmeter across binding posts of cable.

(4) Rotate the H.F. RANGE switch to "C" range (exact frequency is not important).

(5) With MICROVOLTS dial set at 300K point, adjust ring fiducial to obtain one volt on Model 62 (no modulation).

(6) Adjust H.F. VOLTS CAL. potentiometer R-43 until H.F. VOLTS meter, M-1, reads 1.0.

38. ADJUSTMENT OF PLATE VOLTAGE

a. Place the h-f oscillator in an operating range position and set L.F. GAIN control in maximum counter-clockwise position (0% Modulation).

b. Connect a d-c voltmeter having a sensitivity of at least 1000 ohms per volt to frame of H.F. tuning condenser and chassis ground.

c. Adjust potentiometer, R-15, marked H.F. B+ ADJ. until meter reads exactly 180 volts.

39. CALIBRATION OF % MODULATION - L.F. VOLTS METER

a. Make certain plate voltage for H-F tube is exactly 180 volts (see Para. 38).

b. Connect A.C. terminal of the Model 62 Vacuum-Tube Voltmeter to frame of H.F. tuning condenser in H.F. operating position and chassis ground.

c. Rotate L.F. RANGE knob to 200 to 2000-cycle range and tune to approximately 1000 cycles.

d. Adjust L.F. GAIN control until Model 62 reads 63.6 volts (90 volts peak).

e. Adjust potentiometer, R-39, marked L.F. VOLTS METER CAL. to produce full scale (50% modulation) on %-MODULATION scale of meter M-2.

40. LOW-FREQUENCY OSCILLATOR ADJUSTMENT

a. The L.F. OSC. ADJ. control, R-19, is located on the modulator chassis and may be adjusted without removal of the modulator cover. Adjustment will usually be required only when replacement of tubes V-6 or V-7, or the ballast lamp, RT-4, is necessary.

b. After replacement of either tube V-6, V-7 or the ballast lamp RT-4, check output wave-form for distortion.

(1) Connect a 7500-ohm resistive load to AMP. L.F. OUT jack, J-2.

(2) Place L.F. GAIN control at approximately mid-range position.

(3) Connect an oscilloscope across 7500-ohm load resistor.

(4) Observe wave form at several frequencies on each range.

(5) Sufficient feed-back voltage must be employed to start oscillations promptly on lowest frequency range (20-200 cycles).

c. If noticeable distortion is present, rotate the slotted shaft of R-19 counter-clockwise until oscillations cease. Then rotate clockwise to increase feed-back and initiate oscillations.

(1) Visually check several frequencies on each range for waveform.

d. If no oscillations occur after tube or lamp replacement, rotate R-19 clockwise to start oscillations, then repeat procedure of sub-paragraph c. above.

41. FREQUENCY CHECK - H.F. OSCILLATOR

a. The frequency characteristics of the high-frequency oscillator are very stable and will remain within tolerance limits for long periods of time. Occasionally, however, it may be desirable to set the frequency more accurately than the scale calibration will permit. The characteristics of the oscillator tube (V-8) are not critical. However, when a replacement is necessary, the frequency calibration of the generator should be checked. In either case a reliable frequency meter or, preferably, a calibrator such as Measurements Corporation's Model 111 Crystal Calibrator which has been designed specifically for this purpose, will be required. Using the Model 111, calibration points may be checked at 0.25, 1, or 10 megacycle intervals throughout the range of the high-frequency oscillator.

b. Above 250 kilocycles frequency checks are made by beating the output from the signal generator directly with harmonics of the oscillators in the Model 111. For example, a 500-kilocycle signal from the Model 82 will zero beat with the second harmonic of the 0.25-Mc oscillator in the Model 111; a 5-Mc signal will zero-beat with the 5th harmonic of the 1-Mc oscillator. Below 250 kilocycles, however, harmonics of the signal generator frequency will zero-beat with the fundamental and harmonic frequencies of the oscillator in the Model 111. For example, the 5th harmonic of a 100-kilocycle signal will zero-beat with the 2nd harmonic of the 0.25-Mc oscillator, while the 10th harmonic will zero-beat with the fundamental of the 1-Mc oscillator.

c. The recommended procedure for checking the frequency of the Model 82, using the Model 111 Crystal Calibrator, is as follows:

(1) Apply power to Model 82 and Model 111 and allow generator to operate approximately 15 minutes before checking calibration.

(2) Attach an output cable such as Type 80-ZH4, to the H.F. OUT connector on the Model 82 and connect output terminals to the INPUT binding posts on the Model 111; keep leads as short as possible.

(3) Connect a headset to the PHONES jack of the Model 111 and place MOD switch in the OFF position.

(4) Place MEGACYCLES switch of Model 111 in 10-MEGACYCLES position and select "G" range (20 to 50 Mcs) of Model 82. Zero-beat will be heard in the head-phones whenever the generator is tuned through a harmonic 10 megacycles, i.e. 20, 30, 40 and 50 megacycles.

(5) 1-megacycle intervals may be checked by placing the MEGACYCLES switch on the calibrator in 1 position. Similarly, 0.25-megacycle intervals are determined with the MEGACYCLES switch in 0.25 position.

(6) Keep input to Model 111 low to prevent spurious beats.

d. Frequency ranges F, E, D, C & B may be checked in the manner described using suitable frequency intervals. Ranges A & B, the latter between 200 and 250 kilocycles, may also be checked in this manner, but harmonics of the fundamental frequency to which the Model 82 is tuned, will provide the audible beats. As previously mentioned, the input voltage to the calibrator should be kept as low as possible to avoid generating spurious beat-notes.

42. FREQUENCY CHECK - L.F. OSCILLATOR

a. The frequency characteristics of the low-frequency oscillator are extremely stable and the frequency calibration will seldom exceed tolerance limitations. Tube replacements will have negligible effect on frequency calibration.

b. When an accurate determination of test frequency is required, dial calibration may be checked by means of Lissajous figures on the screen of a cathode-ray oscilloscope. This procedure, familiar to most technicians, is described in textbooks and electronic handbooks and will not be described here.

c. Although the Model 111 could be used to check the L.F. Oscillator, it is not recommended for this purpose.

43. TUBE REPLACEMENTS

a. Except as noted below, tubes may be replaced with stock items without affecting operation or accuracy.

(1) H.F. OSCILLATOR - V-8.

(a) This tube may affect the calibration of the high-frequency oscillator. When replacement is necessary the 50-Mc calibration point ("G" band) should be checked, using the Model 111 Crystal Calibrator as described in Paragraph 41, to ascertain that the tube selected will produce a zero-beat within 1% of the calibration mark.

(2) H.F. VOLTMETER TUBES - V-9, V-10, V-11, V-12.

(a) When replacement of these tubes is necessary, the tubes should be purchased in matched pairs (V-9 and V-10 are one pair; V-11 and V-12 another), from Measurements Corporation. This precaution is to insure stable zero adjustment for the H.F. VOLTS meter, (M-1).

44. STEPS NECESSARY TO REPLACE SAMPLING SLIDER ASSEMBLY IN MODEL 82 SIGNAL GENERATOR

a. Remove inner and outer shield can covers from High-Frequency unit. Stand Model 82 on left-hand end so that attenuator tubes point upward.

b. With high-frequency oscillator in blank position, and with both sliders well within tubes, place a suitable padded block of wood between ends of the attenuator tubes and coil turret. Shim to a reasonably tight fit. (This insures proper alignment of sliders in relation to one another and to the ends of the attenuator tubes.)

c. Remove broken phosphor-bronze cable from the pulley. Remove slider assembly. Clean solder from pulley carefully with a file.

d. Disconnect coaxial cable from metering diode assembly.

e. Slide new slider assembly into attenuator tube, with phosphor-bronze cable kept between pulley and slider assembly.

f. Wind cable one turn around pulley in the same direction as cable on other slider assembly and to the left.

g. With both slider assemblies down against wooden block, with output knob and ring fiducial full clockwise against their stops, and holding the sampling slider assembly down against the block with a screw driver in the left hand, pull up on the phosphor-bronze cable with a tension of about seven (7) pounds and have someone solder the phosphor bronze cable to brass plate at the end of the slider assembly. The best way to grip the cable for this operation is with a pair of long-nose pliers, taking hold of the cable end and twisting the pliers two or three times until the cable is wrapped about the jaws of the pliers. It is well to use a 100-watt or 150-watt iron to insure adequate heat for a good solder connection.

h. Following the preceding operation, the ring fiducial may not hit its stop. Turn this Allen screw stop in a turn or two until the ring fiducial just strikes its stop as the sampling loop touches the wood block.

i. Carefully, and with a minimum of solder, tack cable at one point to the pulley. (A transformer-operated, carbon-tip, resistance-heated unit is suggested to heat pulley sufficiently to fuse solder.) Care should be taken not to burn cable.

j. Connect coaxial cable to metering diode assembly.

k. Warm up instrument, and with a suitable V.T.V.M., set the OUTPUT to 0.3V at 500 Kc on "C" range. Then adjust H.F. Volts meter calibration potentiometer until output meter indicates 0.3V.

SECTION VI

CIRCUIT DATA

45. POWER UNIT AND MODULATOR

a. The power unit and modulator consists of tubes V-1, V-2, V-3, V-4 and V-5 and the associated circuits.

b. High a-c voltage applied to the plates of tube V-1 is rectified and supplied through the resistance-capacitance filters consisting of resistors R-2, R-3, R-4, R-5, R-6 and capacitors C-52, C-6A, C-6B, C-6C and C-6D to the plates and screen grids of the oscillator tubes V-6 and V-7 and to the screen grid of control tube V-4.

c. Regulated plate voltage for the h-f oscillator tube V-8 is obtained through the voltage regulator pass tube V-3 in the following manner.

(1) An increase in the potential between the cathode of V-3 and ground produces an increase in the cathode-to-ground potential of tube V-5. The grid potential of V-5 is kept constant by the gas regulator tube V-2. The plate potential of V-5, therefore, increases.

(2) The corresponding increase in grid potential of tube V-4 produces a decrease in its plate potential.

(3) The resulting decrease in the grid potential of tube V-3 increases the equivalent resistance of tube V-3. The corresponding increase in voltage drop from plate to cathode of V-3 opposes the increase in cathode-to-ground voltage of V-3, and, hence, attempts to maintain the output voltage constant.

(4) A decrease in the potential between the cathode of tube V-3 and ground causes the reverse action.

d. Bias potential for the control grid of tube V-4 is developed by the flow of plate current of tube V-5 through resistor R-12. The value of this current is controlled by the setting of potentiometer R-15, which determines the cathode bias of tube V-5. The voltage between the cathode of tube V-3 and ground may be pre-set over a wide range by means of potentiometer R-15.

e. In order to amplitude modulate the high-frequency oscillator V-8, the output of the low-frequency oscillator, or an external modulating voltage, is fed to the grid of V-5 through the L.F. GAIN control R-16. The electronic voltage regulator tubes V-3, V-4 and V-5 then serve as a modulator to superimpose the low-frequency voltage variation on the plate supply of oscillator V-8.

46. LOW-FREQUENCY OSCILLATOR

a. The low-frequency oscillator consists of tubes V-6 and V-7 and the associated circuits.

b. The plate of tube V-6 is coupled to the grid of tube V-7 through capacitor C-15 in the conventional method for resistance-capacitance coupled amplifiers. The plate of tube V-7 is connected through a frequency-selective resistance-capacitance network consisting of resistors R-21 through R-29, fixed capacitors C-12, C-45 and variable capacitor C-14 to the input grid of tube V-6.

c. In this type of circuit, regenerative coupling between output and input is controlled by the frequency-selective network.

(1) Oscillations will occur at a frequency equal to:

$$f = \frac{1}{2\pi\sqrt{R_{series}\ R_{shunt}\ C_{series}\ C_{shunt}}}$$

Where:

f = frequency in cycles per second

R_{Series} = R-21, R-22, R-23 or R-24, depending upon the frequency range selected.

R_{Shunt} = R-26, R-27, R-28 or R-29, depending upon the frequency range selected.

C_{Series} = C-12 in parallel with C-14A.

C_{Shunt} = C-45 in parallel with C-14B.

(2) Variable frequency control is obtained by means of the split stator tuning capacitor C-14.

d. The rapid increase in resistance of the filament of ballast lamp, R-48, with increase in feed-back voltage provides automatic control of the voltage applied to the frequency-selective network. This tends to limit the oscillation to the linear portions of the tube characteristics.

47. HIGH-FREQUENCY UNIT

a. The high-frequency oscillator consists of tube V-8 and its associated circuits.

b. A 6C4 tube, V-8, is used in the oscillator circuit.

c. Band switching is accomplished by rotating a disc, by means of H.F. RANGE knob, on which the seven h-f coils are mounted.

d. The coil in use is so positioned that its magnetic field is concentrated opposite two adjacent tubes which constitute the mutual inductance type attenuator used in this instrument. These tubes function as wave guides below cut-off frequency, and as the magnetic field is attenuated as it traverses through the tube, output voltages will depend upon the position of the coupling loops L-5 or L-6. The rate of attenuation is dependent on the diameter of the attenuator tube, and at low frequencies the decreased skin effect causes the R.F. current to penetrate deeper into the attenuator tube walls bringing about an apparent increase in diameter, and thus, altering the rate of attenuation. This effect is negligible above 1 megacycle, but for greatest accuracy below this frequency, the correction factors found in Figure 2 should be employed.

e. Rotating the ring fiducial of the H.F. ATTENUATOR will adjust simultaneously the position of both coupling loops with respect to the oscillator coil and establish the reference voltage level.

f. The voltage induced in loop L-6 is applied to the plates of tube V-9, which is used as a diode rectifier in a vacuum-tube voltmeter employing H.F. VOLTS meter, M-1, which is calibrated in terms of the output voltage at the end of a terminated cable connected to H.F. OUT jack, J-3, with the MICROVOLTS dial set at 300K.

g. Rotating the MICROVOLTS dial adjusts the position of coupling loop L-5 with respect to the oscillator coil thereby controlling the voltage to output jack, J-3.

48. VACUUM TUBE VOLTMETERS

a. The voltmeters used for indicating output voltage of both the low-frequency and high-frequency oscillators are of the diode vacuum-tube voltmeter type.

b. High-frequency Output Voltmeter.

(1) The meter, M-1, in series with the H.F. VOLTS calibration potentiometer R-43 is connected between the cathodes of the balanced d-c amplifier tubes V-11 and V-12.

(2) One diode of tube V-10 is connected in such a manner that its space charge potential at the grid of V-11 is equal to the space charge potential developed by diode V-9 on the grid of V-12. This results in a stable meter zero with fluctuating heater voltages.

(3) High-frequency voltage developed across the termination resistor, R-38, of the monitor attenuator cable is rectified by tube V-9 which functions as a diode rectifier. This rectified voltage is used to drive the grid of tube V-12, causing an unbalance in the d-c amplifier and a reading on meter M-1. Meter M-1 is calibrated in terms of voltage developed across a terminated 50-ohm cable connected to H.F. OUT jack, J-3.

c. Low-Frequency Output Voltmeter.

(1) The low-frequency output vacuum-tube voltmeter is of the shunt diode type utilizing one section of diode V-10. Since the voltage level monitored is 50 volts, the effects of contact and emission velocity potentials in the diode are negligible. Therefore, the meter, M-2, may be calibrated linearly, and no diode "bucking" circuit is required.

(2) The shunt diode circuit responds to the peak value of the low-frequency voltage appearing across the output of the low-frequency amplifier tube V-3 from cathode to ground. The meter M-2, however, is calibrated in terms of the r.m.s. value of this voltage, and in terms of the percent modulation of the high-frequency oscillator.

APPENDIX I

STORAGE AND SHIPMENT

1. STORAGE

a. Remove dust from controls and outer surface of instrument with a clean rag.

b. Wrap instrument in heavy wrapping paper and seal seams with gummed tape or similar adhesive.

c. Store in a dry place. If excessive humidity is unavoidable, the wrapped instrument should be placed in a moisture-proof bag with a sufficient quantity of drying agent, such as silica gel, to insure a dry atmosphere. When the use of bag and desiccant is necessary, the instrument should be checked at six month intervals to determine the effectiveness of the seal.

2. SHIPMENT

a. Wrap the instrument with heavy wrapping paper and seal seams with gummed tape or similar adhesive.

b. Place in fibre-board carton or wooden box large enough to permit at least three inches of excelsior or similar packing material between the instrument and sides of the box. For export packing, the instrument must be wrapped in waterproof paper and the seams sealed with waterproof glue or similar sealing compound before being placed in a wooden box.

APPENDIX II

TABLE OF REPLACEABLE PARTS

Model 82 Signal Generator

Symbol	Meas. Corp. Part No.	Description
CAPACITORS		
C1	H-5356	Fixed; ceramic; 10,000 mmf; 600 V.
C2	H-5356	Fixed; ceramic; 10,000 mmf; 600 V.
C3	H-5001	Fixed; ceramic; 5,000 mmf.
C4	H-5001	Fixed; ceramic; 5,000 mmf.
C5	H-5002	Fixed; electro; 8 mfd; 450 V.
C6A) B) C) D)	H-5003	Fixed; electro; 20-20-20-20 mfd; 450 V.
C7	H-5002	Fixed; electro; 8 mfd; 450 V.
C8	H-5358	Fixed; electro; 40 mfd; 250 V.
C9	H-5005	Fixed; electro; 40 mfd; 150 V.
C10	H-3755	Fixed; paper.
C11	H-5002	Fixed; electro; 8 mfd; 450 V.
C12	H-5007	Variable; air; 4-50 mmf.
C13		Not used.
C14A) B)	H-2708	Variable; air.
C15	H-3761	Fixed; paper.
C16	H-5009	Fixed; mica; .001 mfd, ± 20%; 500 V.
C17	H-5010	Fixed; mica; 500 mmf, ± 20%; 500 V.
C18	H-5516	Fixed; paper; .05 mfd; 400 V.
C19	H-5516	Fixed; paper; .05 mfd; 400 V.
C20	H-5516	Fixed; paper; .05 mfd; 400 V.

Symbol	Meas. Corp. Part No.	Description
CAPACITORS		
C21	H-5001	Fixed; ceramic, 5,000 mmf.
C22	H-5009	Fixed; mica; .001 mfd, ± 20%; 500 V.
C23	H-5009	Fixed; mica; .001 mfd, ± 20%; 500 V.
C24A) B)	H-2707	Variable; air.
C26	H-4121	Fixed; ceramic; .001 mfd.
C27		Not used.
C28	H-3761	Fixed; paper
C29	H-5001	Fixed; ceramic; 5,000 mmf.
C30	H-5001	Fixed; ceramic; 5,000 mmf.
C31		Not used.
C32	H-5001	Fixed; ceramic; 5,000 mmf.
C33	H-5012	Fixed; ceramic; 8.2 mmf, ± 10%.
C34	H-5012	Fixed; ceramic; 8.2 mmf, ± 10%.
C35	H-5013	Fixed; ceramic; 5.6 mmf, ± 10%.
C36		Not used.
C37	H-5566	Fixed; ceramic, 1500 mmf.
C38		Not used.
C39		Not used.
C40	H-5015	Fixed; ceramic; 100 mmf, ± 5%.
C41	H-5015	Fixed; ceramic; 100 mmf, ± 5%.
C42	H-5015	Fixed; ceramic; 100 mmf, ± 5%.
C43	H-5359	Fixed; ceramic; 33 mmf, ± 10%.
C44	H-5360	Fixed; ceramic; 22 mmf, ± 5%.

Symbol	Meas. Corp. Part No.	Description
C45	H-5361	Variable; air; 3-25 mmf.
C46		Not used.
C47	H-5566	Fixed; ceramic; 1500 mmf.
C48	H-5566	Fixed; ceramic; 1500 mmf.
C49	H-5004	Fixed; electro; 20 mfd; 250 V.
C50	H-5001	Fixed; ceramic; 5000 mmf.
C51	H-5001	Fixed; ceramic; 5000 mmf.
C52	H-5557	Fixed; electro; 20 mfd; 450 V.
C53	H-5358	Fixed; electro; 40 mfd; 250 V.
C54	H-6671-7	Fixed; ceramic; 47 mmf, NPO ± 10%.
CR1	H-2948	Rectifier.
CR2	H-2948	Rectifier.
E1	H-5016	LAMP, 6-8 V., 0.25 amp.
F1	H-5018-8	FUSE, 8/10 amp. (115-volt operation)
	(H-5018-5)	(FUSE, 4/10 " 230-volt operation)
J1	H-5020	JACK.
J2	H-5020	JACK.
J3		RECEPTACLE, UG-58/U.

Symbol	Meas. Corp. Part No.	Description
L1	H-2325	CHOKE: R.F., 50 millihenries, ± 5%.
L2	H-2325	CHOKE: R.F., 50 millihenries, ± 5%.
L3	H-2316	CHOKE: 15 microhenries.
L4	H-2316	CHOKE: 15 microhenries.
L5	Pt. of H-3094	COIL.
L6	Pt. of H-3095	COIL.
L7	H-3072	COIL, "A" Band.
L8		Not used.
L9	H-3073	COIL, "B" Band.
L10		Not used.
L11	H-3074	COIL, "C" Band.
L12		Not used.
L13	H-3075	COIL, "D" Band.
L14		Not used.
L15	H-3076	COIL, "E" Band.
L16	H-3077	COIL, "F" Band.
L17	H-3078	COIL, "G" Band.
L18	H-2320	CHOKE, 0.2 millihenries.
M1	H-855	METER: "H.F. Volts"
M2	H-854	METER: "% Modulation - L.F. Volts"

Symbol	Meas. Corp. Part No.	Description
RESISTORS		
R1	H-3733-513	Fixed; composition; 51,000 ohms, ± 5%, 2 W.
R2	H-3734-682	Fixed; composition, 6800 ohms, ± 10%, 2 W.
R3	H-3734-682	Fixed; composition; 6800 ohms, ± 10%, 2 W.
R4	H-3734-682	Fixed; composition; 6800 ohms, ± 10%, 2 W.
R5	H-3734-152	Fixed; composition; 1500 ohms, ± 10%, 2 W.
R6	H-3734-152	Fixed; composition; 1500 ohms, ± 10%, 2 W.
R7	H-3734-222	Fixed; composition; 2200 ohms, ± 10%, 2 W.
R8	H-3734-102	Fixed; composition; 1000 ohms, ± 10%, 2 W.
R9	H-3734-152	Fixed; composition; 1500 ohms, ± 10%, 2 W.
R10	H-6692D3124P	Fixed; film; 3.12 M ± 2%, 1 W.
R11	H-6692D6343P	" " 634 K ± 2%, 1 W.
R12	H-3728-153	Fixed; composition; 15,000 ohms, ± 10%, 1/2 W.
R13	H-3734-153	Fixed; composition; 15,000 ohms, ± 10%, 2 W.
R14A	H-6692D4992Q	Fixed; film; 49.9 K ± 5%, 1 W.
R14B	H-6692D4992Q	" " 49.9 K ± 5%, 1 W.
R15	H-5032	Variable; wirewound; 10,000 ohms, ± 10%, Scr. Dr. Adj.
R16	H-5033	Variable; composition; 100,000 ohms.
R17		Not used.

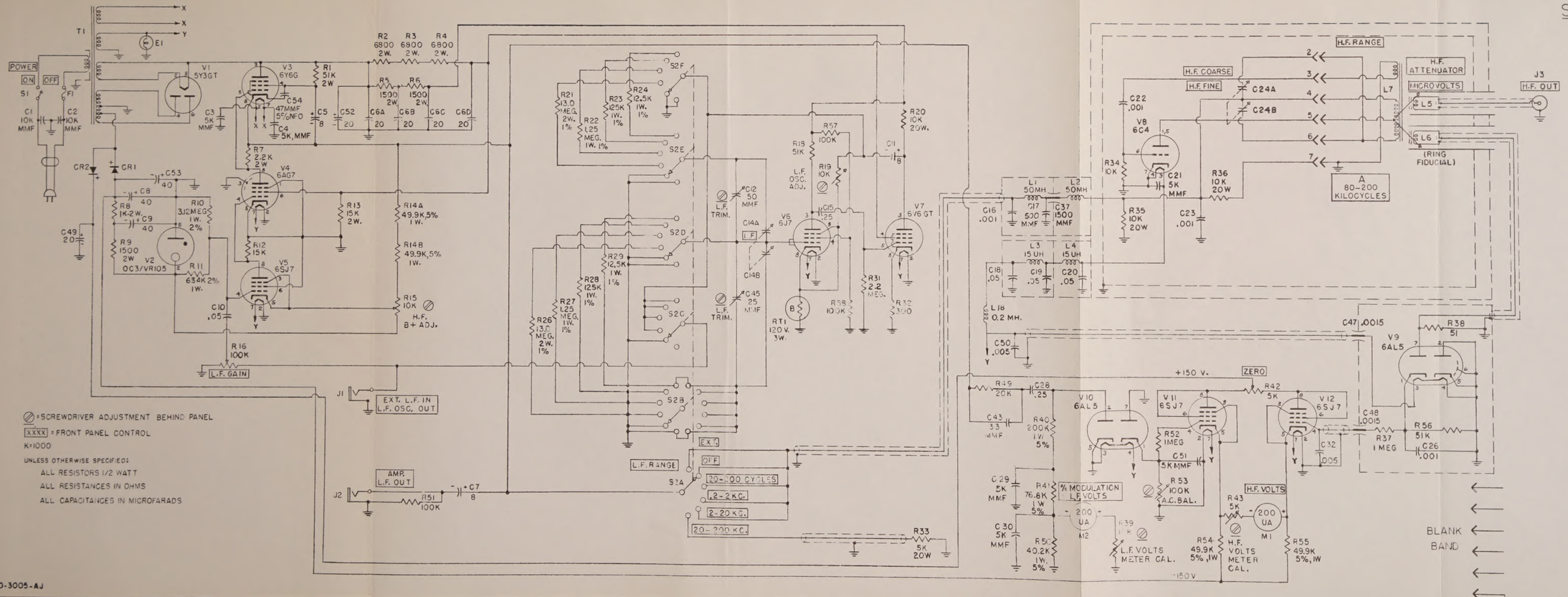
Symbol	Meas. Corp. Part No.	Description
RESISTORS		
R18	H-3727-513	Fixed; composition; 51,000 ohms, ± 5%, 1/2 W.
R19	H-5032	Variable; wirewound; 10,000 ohms, ± 10%, Scr. Dr. Adj.
R20	H-5352	Fixed; wirewound; 10,000 ohms, ± 10%, 20 W.
R21	H-6693B1305F	Fixed; film; 13 M ± 1%, 2 W.
R22	H-6692D1254F	Fixed; film; 1.25 M ± 1%, 1 W.
R23	H-6692D1253F	Fixed; film; 125 K ± 1%, 1 W.
R24	H-6692D1252F	Fixed; film; 12.5 K ± 1%, 1 W.
R25		Not used.
R26	H-6693B1305F	Fixed; film; 13 M ± 1%, 2 W.
R27	H-6692D1254F	Fixed; film; 1.25 M ± 1%, 1 W.
R28	H-6692D1253F	Fixed; film; 125 K ± 1%, 1 W.
R29	H-6692D1252F	Fixed; film; 12.5 K ± 1%, 1 W.
R30		Not used.
R31	H-3728-225	Fixed; composition; 2.2 meg., ± 10%, 1/2 W.
R32	H-3727-301	Fixed; composition; 300 ohms, ± 5%, 1/2 W.
R33	H-5044	Fixed; wirewound, 5000 ohms, ± 10%, 20 W.
R34	H-3728-103	Fixed; composition; 10,000 ohms, ± 10%, 1/2 W.
R35	H-5352	Fixed; wirewound; 10,000 ohms, ± 10%, 20 W.
R36	H-5352	Fixed; wirewound; 10,000 ohms, ± 10%, 20 W.
R37	H-3728-105	Fixed; composition; 1 meg., ± 10%, 1/2 W.

Symbol	Meas. Corp. Part No.	Description
RESISTORS		
R38	H-3727-510	Fixed; composition; 51 ohms, ± 5%, 1/2 W.
R39	H-5032	Variable; wirewound; 10,000 ohms, ± 10%, Scr. Dr. Adj.
R40	H-6692D2003Q	Fixed; film; 200 K ± 5%, 1 W.
R41	H-6692D7682Q	Fixed; film; 76.8 K ± 5%, 1 W.
R42	H-5218	Variable; wirewound; 5000 ohms.
R43	H-5362	Variable; wirewound; 5000 ohms.
R44		Not used.
R45	H-3728-221	Fixed; composition; 220 ohms, ± 10%, 1/2 W.
R46	H-3728-221	Fixed; composition; 220 ohms, ± 10%, 1/2 W.
R47	H-3728-221	Fixed; composition; 220 ohms, ± 10%, 1/2 W.
R48		Not used.
R49	H-3727-203	Fixed; composition; 20,000 ohms, ± 5%, 1/2 W.
R50	H-6692D4022Q	Fixed; film; 40.2 K ± 5%, 1 W.
R51	H-3728-104	Fixed; composition; 100,000 ohms, ± 10%, 1/2 W.
R52	H-3728-105	Fixed; composition; 1 megohm, ± 10%, 1/2 W.
R53	H-5363	Variable; composition; 100,000 ohms.
R54	H-6692D4992Q	Fixed; film; 49.9K± 5%, 1 W.
R55	H-6692D4992Q	Fixed; film; 49.9K± 5%, 1 W.
R56	H-3727-513	Fixed; composition; 51,000 ohms, ± 5%, 1/2 W.
R57	H-3728-104	Fixed; composition; 100,000 ohms, ± 10%, 1/2 W.
R58	H-3728-104	Fixed; composition; 100,000 ohms, ± 10%, 1/2 W.
RT1	H-5052	Lamp; 3 W, 120 volts.

Symbol	Meas. Corp. Part No.	Description
SWITCHES		
S1	H-383-1	Toggle.
S2	H-3136	Rotary.
T1	H-3011	Transformer.
V1		Electron, RETMA, TUBE, 5Y3GT.
V2		Electron, RETMA, TUBE, 0C3/VR105.
V3		Electron, RETMA, TUBE, 6Y6G.
V4		Electron, RETMA, TUBE, 6AG7.
V5		Electron, RETMA, TUBE, 6SJ7.
V6		Electron, RETMA, TUBE, 6J7.
V7		Electron, RETMA, TUBE, 6V6GT.
V8		Electron, RETMA, TUBE, 6C4.
V9		Electron, RETMA, TUBE, 6AL5.
V10		Electron, RETMA, TUBE, 6AL5.
V11		Electron, RETMA, TUBE, 6SJ7.
V12		Electron, RETMA, TUBE, 6SJ7.

SCHEMATIC DIAGRAM

MODEL 82



⊘ = SCREWDRIVER ADJUSTMENT BEHIND PANEL

XXXX = FRONT PANEL CONTROL

K=1000

UNLESS OTHERWISE SPECIFIED:

ALL RESISTORS 1/2 WATT

ALL RESISTANCES IN OHMS

ALL CAPACITANCES IN MICROFARADS

D-3005-AJ

MEASUREMENTS

BOX 180, BOONTON
NEW JERSEY

MP MASTER
MA25145